

KERR'S GRAVITY AS A QUANTUM GRAVITY ON THE COMPTON LEVEL*

ALEXANDER BURINSKII

*Gravity Research Group, NSI Russian Academy of Sciences,
B. Tulkaya 52, Moscow 115191, Russia, bur@ibrae.ac.ru*

The Dirac theory of electron and QED neglect gravitational field, while the corresponding to electron Kerr-Newman gravitational field has very strong influence on the Compton distances. It polarizes space-time, deforms the Coulomb field and changes topology. We argue that the Kerr geometry may be hidden beyond the Quantum Theory, representing a complimentary space-time description.

1.Introduction. The Kerr-Newman solution displays many relationships to the quantum world. It is the anomalous gyromagnetic ratio $g = 2$, stringy structures and other features allowing one to construct a semiclassical model of the extended electron¹⁻⁴ which has the Compton size and possesses the wave properties. Meanwhile, the quantum theory neglects the gravitation at all. The attempts to take into account gravity are undertaken by superstring theory which is based on the space-time description of the extended stringy elementary states: *Points* \longrightarrow *Extended Strings*, and also, on the unification of the Quantum Theory with Gravity on Planckian level of masses M_{pl} , which correspond to the distances of order 10^{-33} cm.

Note, that spin of quantum particles is very high with respect to the masses. In particular, for electron $S = 1/2$, while $m \approx 10^{-22}$ (in the units $G = \hbar = c = 1$). So, to estimate gravitational field of spinning particle, one has to use the Kerr, or Kerr-Newman solutions,⁵ contrary to the ordinary estimates based on spherical symmetric solutions.

Performing such estimation, we obtain a striking contradiction with the above scale of Quantum Gravity !

Indeed, for the Kerr and Kerr-Newman solutions we have the basic relation between angular momentum J , mass m and radius of the Kerr singular ring a : $J = ma$. Therefore, Kerr's gravitational field of a spinning particle is extended together with the Kerr singular ring up to the distances $a = J/m = \hbar/2m \sim 10^{22}$ which are of the order of the Compton length of electron 10^{-11} cm., forming a singular closed string^a. Therefore, in analogy with string theory *the 'point-like' Schwarzschild singularity turns in the Kerr geometry into an extended string of the Compton size.*

Note, that the Kerr string is not only analogy. It was shown that the Kerr singular ring is indeed the string,⁸ and, in the analog of the Kerr solution to low energy string theory,⁹ the field around the Kerr string is similar to the field around a heterotic string.¹⁰ Besides, the Kerr space exhibits a change of topology on the

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^aSee also.^{1,6-8}

Compton distances, since the Kerr string is an Alice topological string.⁴ Therefore, the Kerr geometry indicates essential peculiarities of space-time on the Compton distances, and the use of Kerr geometry for estimation of the scale of Quantum Gravity gives the striking discrepancy with respect to the ordinary estimations based on the Schwarzschild geometry.

There appears the Question: “Why Quantum Theory does not feel such drastic changes in the structure of space time on the Compton distances?” How can such drastic changes in the structure of space-time and electromagnetic field be experimentally unobservable and theoretically ignorable in QED?

There is, apparently, unique explanation to this contradiction. We have to assume that the Kerr geometry *is already taken into account in quantum theory* and play there an important role. In another words, the Kerr geometry is a complementary (dual) space-time description of quantum processes.

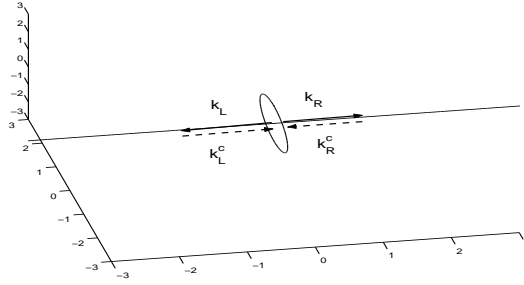


Fig. 1. Skeleton of the Kerr spinning particle in the rest frame: the Kerr singular ring and two semi-infinite singular half-strings which are determined by two null-vectors of polarization of a free electron.

Indeed, the local gravitational field at these distances is extremely small on average, and the strong field is concentrated near an extremely narrow vicinity of the Kerr singular ring forming a closed string of the Compton radius. This closed Kerr string is presumably the source of quantum effects.

Such point of view coincides with the old conjecture on the Kerr spinning particle as a model of electron, a ‘microgeon’ model, where the spin and mass of electron are related with e.m. and spinor excitations of the Kerr closed string.¹⁻³ The compatible with the Kerr geometry ‘aligned’ excitations^{2,3} have a peculiarity in the form of two extra semi-infinite singular half-strings, as it is shown on fig.1.

Excitations of the Kerr circular string of the Compton size $a = \hbar/m$ have the wave lengths $\lambda = \frac{a}{2n}$, and, as usual in string theory, generate the mass $m = E = \hbar c/\lambda$ and spin of particle $J = ma = \hbar/2$. In the same time, the waves induced by excitations on the axial strings carry de’Broglie periodicity.^{2,3}

Vacuum polarization near the singular strings leads to the formation of a false vacuum, so there has to be a phase transition near the sources,⁴ and the Kerr spinning particle turns out to be dressed, taking the form shown on fig.2.

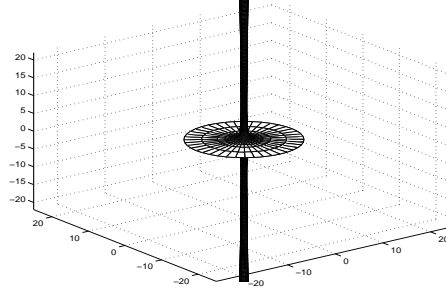


Fig. 2. Image of the dressed Kerr spinning particle.

One of the often discussed objections against the Compton size of electron is the argument based on the experiments on the deep inelastic scattering of electron which demonstrates its almost point-like structure. Explanation of this problem may be divided on two parts:

a) the point like exhibition of the structure of electron may be related with the complex representation of the Kerr source which *is point-like from complex point of view*.^{2,11} Working in the momentum space, one can feel namely this point-like structure. On the real space-time slice it is realized as a contact interaction of the ‘axial’ strings;²

b) the space-time Compton extension of electron has also been observed in the low-energy experiments with a coherent resonance scattering of electron.¹² In this relation, the experiments with polarized electrons has to be the most informative.

Finally, one can mention the obtained recently multiparticle Kerr-Schild solutions¹³ which show that theory of electron is to be multiparticle one, indeed.

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